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Summer Benthic Fish Fauna of Sandy Hook Bay, New Jersey

STUART J. WILK and MYRON J. SILVERMAN

SEATTLE, WA
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STUART J. WILK and MYRON J. SILVERMAN[1]

ABSTRACT

Thirty-eight species and 25 families of fishes were captured during an otter trawl survey in Sandy Hook Bay, N.J., during July to October 1970. Distribution, abundance, length and age composition, and environmental preferences were analyzed for the more numerous species. Winter flounder, *Pseudopleuronectes americanus*; striped searobin, *Prionotus evolans*; windowpane, *Scophthalmus aquosus*; and northern searobin, *Prionotus carolinus*, accounted for 68.3% by number and 66.4% by weight of the total survey catch.

INTRODUCTION

Historically, Sandy Hook Bay has supported commercial fisheries since the early days of settlement in the United States (True 1887). Within the past half century, water quality has deteriorated largely from sewage (Federal Water Pollution Control Administration 1967) and industrial waste contamination, and much of the bay bottom is now unfit for shellfish harvest. Only a few pound nets and purse seines are currently operated in the bay, but year-round and seasonally intensive small boat and shore recreational fisheries have developed. The following report of a systematic trawl survey of finfish is the first of several to be undertaken in Sandy Hook Bay, and provides baseline observations for future comparison of biological and environmental changes in the area.

Otter trawl hauls were made from July to October 1970 to determine summer species composition, relative abundance, and distribution of benthic fishes in Sandy Hook Bay. All catch data are summarized, together with length-frequency data and estimates of age composition and summer growth rates based on published age-length information.

DESCRIPTION OF STUDY AREA

Sandy Hook Bay is bounded on the north by Lower Bay, on the south and west by the New Jersey mainland, from which it receives drainage of the Navesink and Shrewsbury rivers, and on the east is separated from the Atlantic Ocean by Sandy Hook peninsula. To establish uniform sampling areas, the bay was divided into 18 blocks (Fig. 1). Except where interrupted by land, each block measured 1' lat. × 1' long., i.e., 1.8 km × 1.4 km (1.0 × 0.75 nautical mile).

MATERIALS AND METHODS

All 18 blocks were sampled, as close to biweekly as possible, during 2-day cruises when weather conditions and vessel scheduling permitted.

Our vessel was the Middle Atlantic Coastal Fisheries Center's *Martha-E II*, a 10.4-m (34-foot) diesel-powered research vessel equipped with hydraulic trawl winch, trawl boom, electronic navigation equipment, and electronic depth recorders.

At each sampling station, surface and bottom temperature and salinity were measured with a portable thermometer-salinometer probe. Station depth, bottom contours, and fish concentrations were observed with white-line fathometers aboard the vessel. The otter trawl was towed for 10 min at approximately 5.6 km/h (3 knots) in each sample block. The two-seam trawl used had the following dimensions: 9.1-m (30-foot) footrope and 7.6-m (25-foot) headrope; 64-mm (2.25-inch) stretched mesh 18-thread knotted nylon in the body of the trawl and 51-mm (2-inch) stretched mesh 18-thread knotless nylon in the cod end. During each trawl tow, frequent navigational checks were made to remain within a sample block. Although towing time remained constant, both direction and distance of the tow were governed by tide, current, wind, and starting location.

At the conclusion of each tow, the trawl was retrieved and emptied on the afterdeck of the vessel, where the fishes were sorted and identified. All specimens of each species were weighed and a random sample of 20-25 specimens measured to the nearest centimeter (total length). Usually, all specimens of each species were counted; but, when a species was very numerous, an estimate of the total was made by counting and weighing the fish in a subsample.

Physical and biological data collected were recorded on punch cards and subsequently sorted, mapped, and analyzed by computer.

Common and scientific names used follow those listed by the American Fisheries Society (Bailey et al. 1970).

RESULTS

During the 3.5-mo study, 112 station blocks were occupied on 15 sample dates. Data were grouped into eight sample periods of seven 2-day cruises and one 1-day cruise.

The results of our collections are presented as follows:

1. List of bottom temperature, salinity, and depth observed at each otter trawl station, including summary data on station blocks and sample periods (Table 1).

2. List of species caught in descending order of abundance, including summaries of each species and sample period (Appendix Table 1).

3. Phylogenetic list summarizing all parameters for each species (Appendix Table 2).

4. Maps of the average number and weight of all fish caught per 10-min tow (Figs. 2, 3).

5. Maps of the distribution of average catch (no.) per 10-min tow for 10 of the most numerous species (Figs. 4-13).

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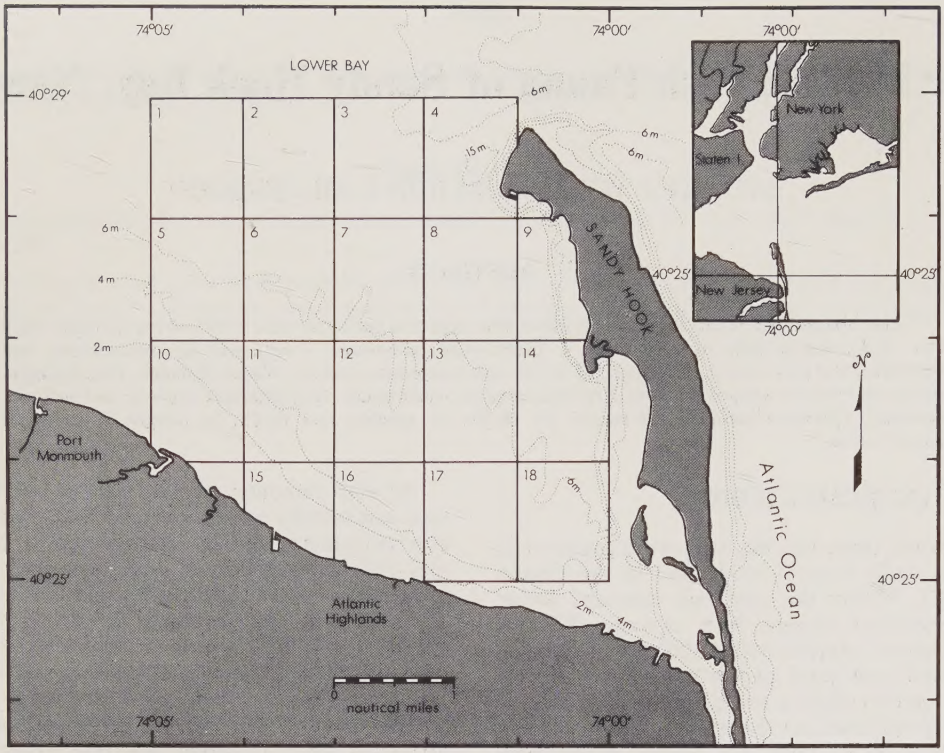

Figure 1.—Outline of Sandy Hook Bay, N.J., divided into 18 blocks where finfish were sampled during an otter trawl survey, July to October 1970.

6. Length-frequency distributions representing the size distribution and changes in the size composition during the survey of eight species (Figs. 14-21).

SUMMARY

Four species—winter flounder, *Pseudopleuronectes americanus*; striped searobin, *Prionotus evolans*; windowpane, *Scophthalmus aquosus*; and northern searobin, *Prionotus carolinus*—accounted for 68.3% by number and 66.4% by weight of the total catch during the survey. Although 10 of the most abundant species accounted for 95.0% by number and 84.6% by weight of the total catch, only seven species occurred in more than 25% of the collections (Appendix Table 1).

Catches in the northern half of Sandy Hook Bay (station blocks 1-9) contained a total of 35 species; those in the southern half (station blocks 10-18) 22 species (Appendix Table 2). The total catch both by weight and number in the northern half exceeded that of the southern half (Figs. 2, 3). The greater abundance and diversity of species in the northern half of the survey area were believed to be related to the deeper and slightly colder water found there (Table 1) and proximity to the ocean (Fig. 1).

The bay appears to provide a summer residence for several important recreational and commercial species, primarily red hake, *Urophycis chuss*; bluefish, *Pomatomus salatatrix*; scup, *Stenotomus chrysops*; weakfish, *Cynoscion regalis*; butterfish, *Peprilus triacanthus*; summer flounder, *Paralichthys dentatus*; and winter flounder, *Pseudopleuronectes americanus* (Appendix Table 2).

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Table 1.--Bottom temperature (T in °C), salinity (S in ppt), and depth (m) observed at otter trawl stations in Sandy Hook Bay, N. J., July to October 1970.

Station block		Sample period: July 2	July 16-17	July 30-31	August 13-14	August 27-28	September 10-11	September 24-25	October 15-16	Mean temp. and sal.	Mean depth
		1	2	3	4	5	6	7	8		
1	T	19.0	-	21.9	23.0	25.4	-	21.9	18.9	21.7	7.7
	S	26.2	-	26.1	27.4	26.8	-	28.8	26.3	26.9	
2	T	18.9	-	21.6	23.2	-	20.7	21.7	18.8	20.8	7.5
	S	26.1	-	26.3	27.7	-	27.8	27.8	26.8	27.1	
3	T	18.8	-	21.4	24.2	-	-	21.5	-	21.5	10.6
	S	26.8	-	26.8	27.6	-	-	29.4	-	27.7	
4	T	19.8	21.0	22.9	24.4	24.1	20.7	22.4	-	22.2	7.7
	S	26.0	26.4	26.2	27.3	26.7	28.1	28.2	-	27.0	
5	T	-	22.5	21.8	24.2	23.4	21.5	21.8	19.0	22.0	5.4
	S	-	25.3	25.9	26.8	27.0	27.0	27.7	27.1	26.7	
6	T	19.1	19.8	21.4	23.5	23.1	20.6	22.4	18.8	21.1	7.3
	S	26.5	27.1	26.7	27.5	27.5	28.1	28.3	26.2	27.2	
7	T	18.4	-	20.8	23.5	-	20.5	22.2	18.7	20.7	10.3
	S	27.3	-	27.0	28.0	-	28.5	28.8	26.6	27.7	
8	T	-	20.4	21.8	23.9	23.1	-	22.3	-	22.3	6.2
	S	-	26.6	26.6	27.6	27.6	-	29.5	-	27.6	
9	T	21.2	-	23.3	24.3	23.4	20.6	22.5	-	22.6	5.5
	S	25.0	-	26.3	27.6	26.8	28.3	28.6	-	27.1	
10	T	-	22.0	22.2	24.7	23.5	21.4	23.9	19.2	22.4	3.6
	S	-	25.3	26.0	26.7	26.5	26.7	26.4	25.6	26.2	
11	T	-	21.9	23.2	24.9	24.4	21.5	24.2	19.4	22.8	2.5
	S	-	25.6	25.8	26.8	25.8	27.0	26.6	25.7	26.2	
12	T	-	20.4	21.4	23.7	22.8	20.4	22.5	18.9	21.4	5.3
	S	-	26.6	27.0	27.4	27.2	28.5	28.0	26.1	27.3	
13	T	-	22.2	21.4	24.3	22.7	-	22.2	18.0	21.8	5.9
	S	-	26.0	27.0	27.1	27.5	-	28.2	26.0	27.0	
14	T	-	22.3	21.4	23.8	23.1	22.1	22.1	-	22.5	5.1
	S	-	26.0	26.9	27.5	27.3	27.5	27.7	-	27.2	
15	T	-	21.6	21.9	24.5	24.3	21.3	24.6	19.2	22.5	3.5
	S	-	25.8	26.1	26.8	26.0	27.6	26.1	25.9	26.3	
16	T	-	21.9	21.8	23.5	23.5	-	22.2	18.1	21.8	4.6
	S	-	25.8	26.7	27.4	26.9	-	27.2	26.5	26.8	
17	T	-	22.1	21.5	23.5	23.5	20.9	22.1	-	22.3	5.0
	S	-	26.2	26.9	27.5	26.7	28.0	27.7	-	27.2	
18	T	-	21.4	21.4	24.1	24.1	-	21.9	-	22.6	5.4
	S	-	26.3	27.0	27.4	26.0	-	27.7	-	26.9	
Mean	T	19.3	21.5	21.8	24.0	23.6	21.0	22.5	18.8	21.9	5.9
	S	26.3	26.1	26.5	27.3	26.8	27.8	27.9	26.3	27.0	

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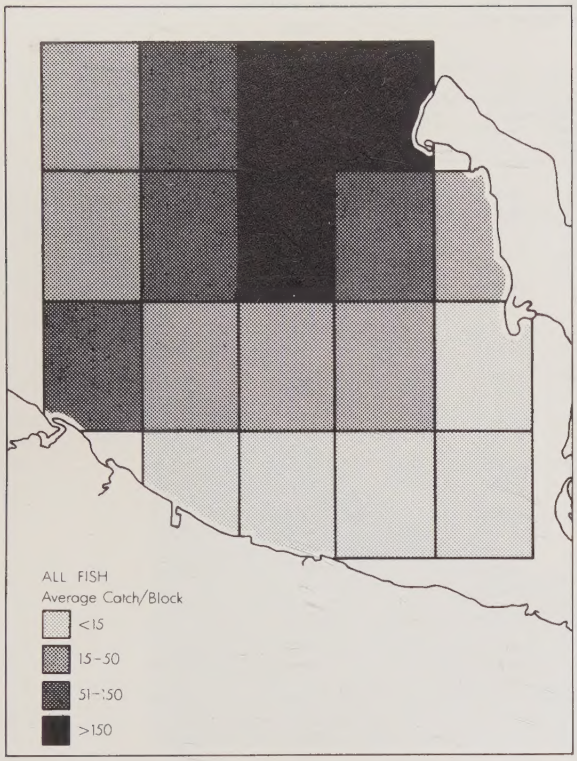

Figure 2.—The average catch (no.) of all fish per 10-min tow in Sandy Hook Bay, N.J., July to October 1970.

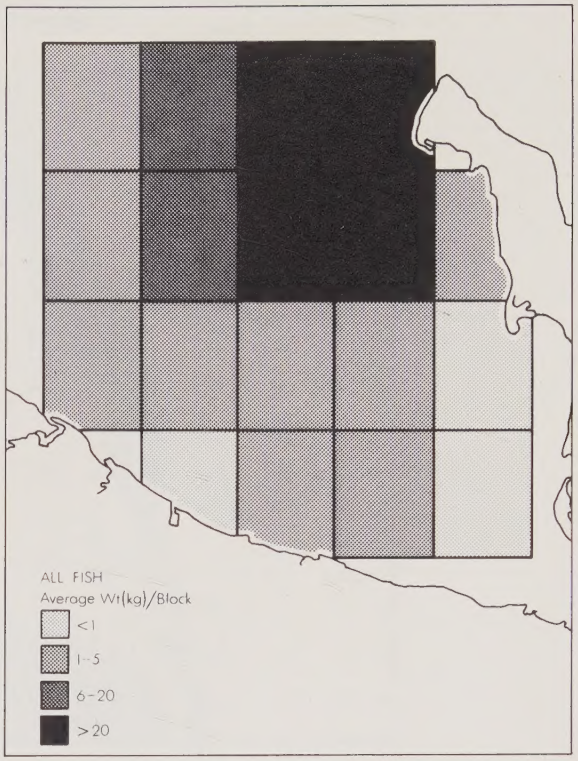

Figure 3.—The average weight (kg) of all fish caught per 10-min tow in Sandy Hook Bay, N.J., July to October 1970.

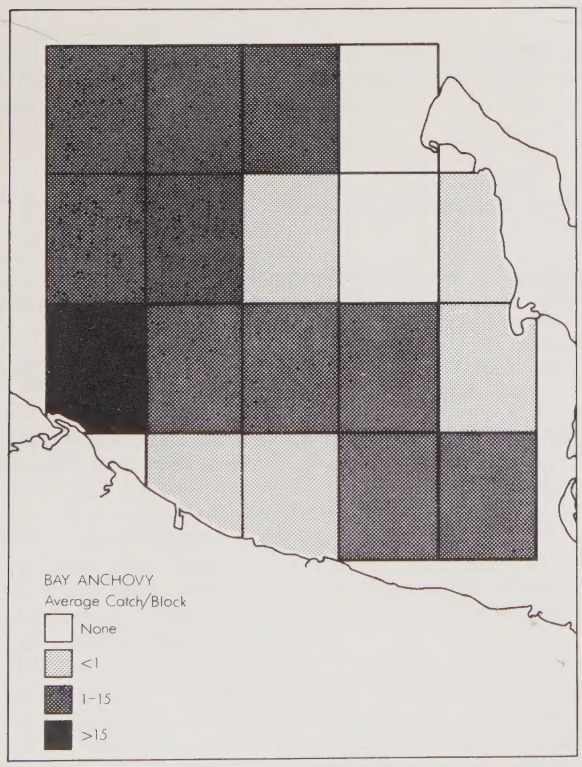

Figure 4.—The average catch (no.) of bay anchovy, *Anchoa mitchilli*, per 10-min tow in Sandy Hook Bay, N.J., July to October 1970.

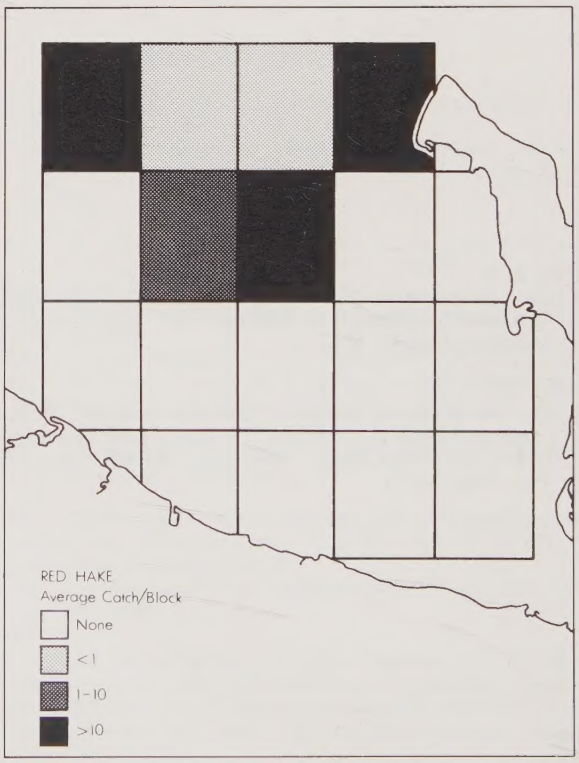

Figure 5.—The average catch (no.) of red hake, *Urophycis chuss*, per 10-min tow in Sandy Hook Bay, N.J., July to October 1970.

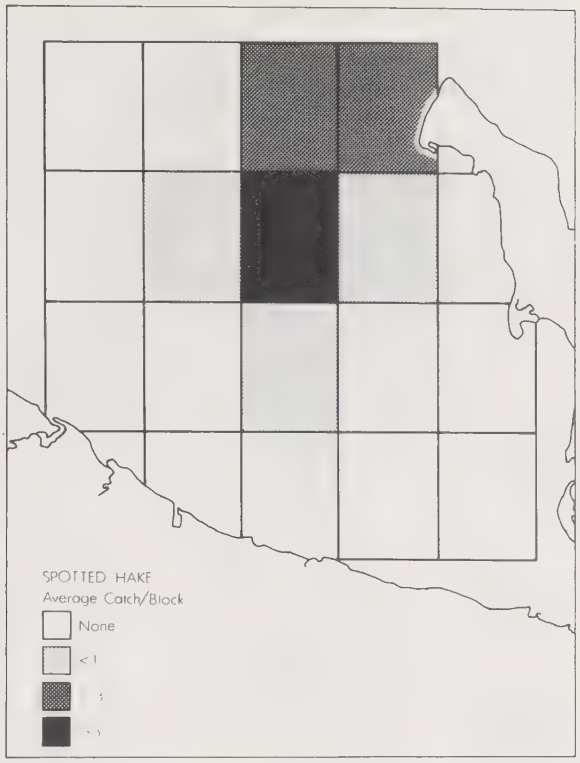

Figure 6.—The average catch (no.) of spotted hake, *Urophycis regius*, per 10-min tow in Sandy Hook Bay, N.J., July to October 1970.

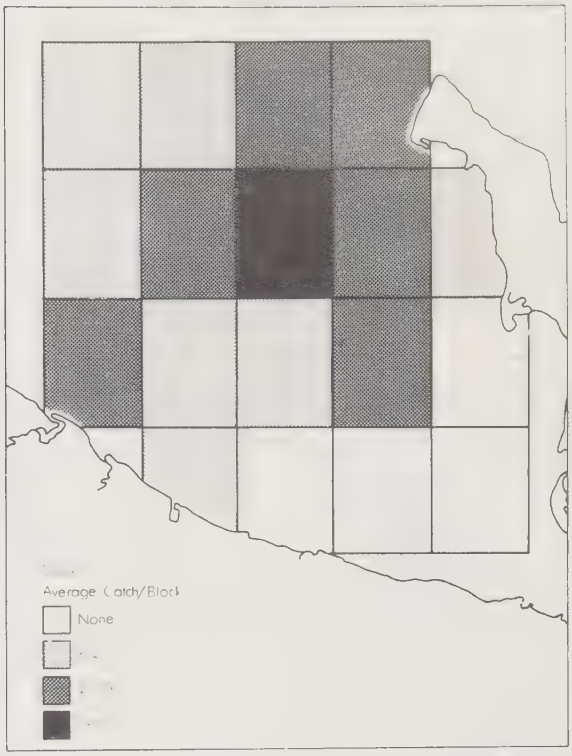

Figure 7.—The average catch (no.) of scup, *Stenotomus chrysops*, per 10-min tow in Sandy Hook Bay, N.J., July to October 1970.

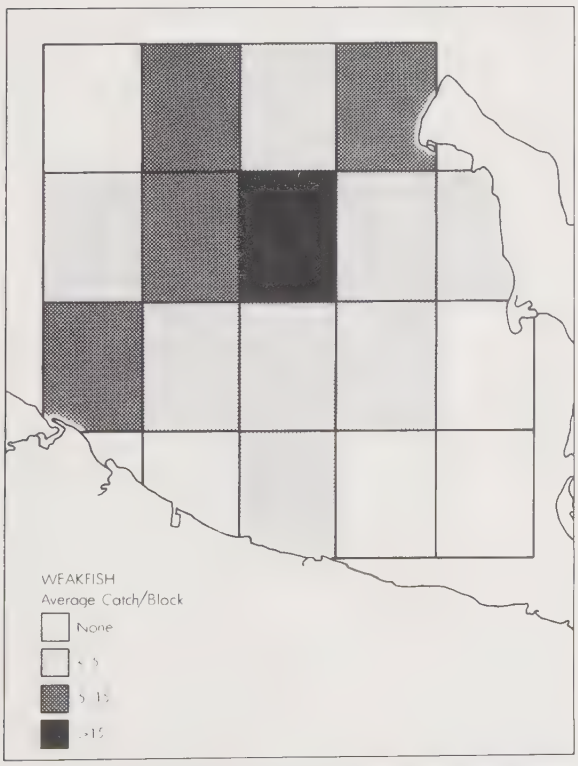

Figure 8.—The average catch (no.) of weakfish, *Cynoscion regalis*, per 10-min tow in Sandy Hook Bay, N.J., July to October 1970.

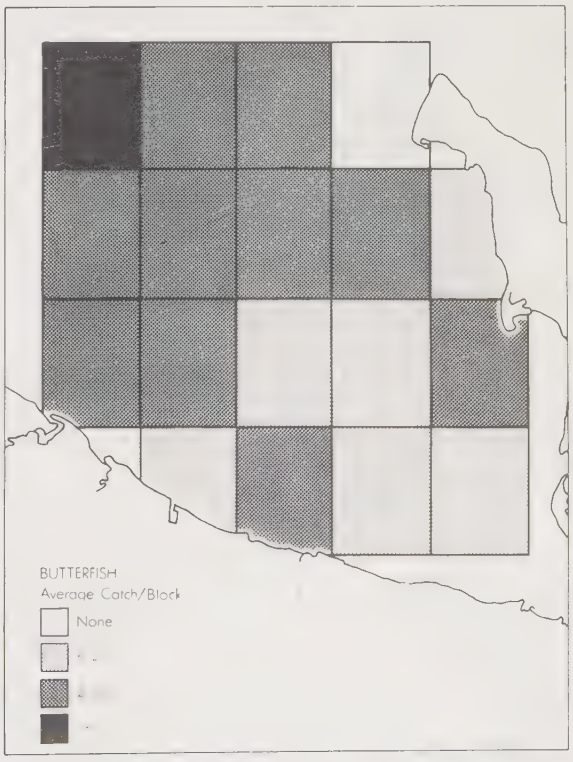

Figure 9.—The average catch (no.) of butterfish, *Peprilus triacanthus*, per 10-min tow in Sandy Hook Bay, N.J., July to October 1970.

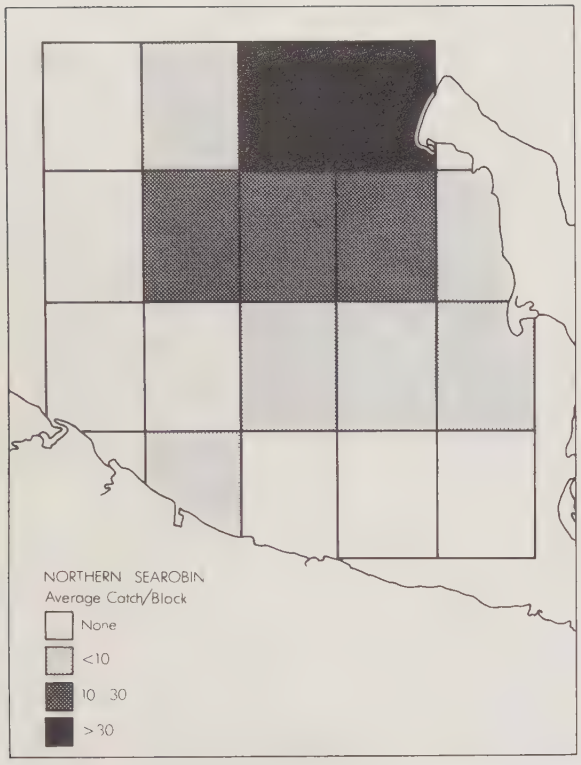

Figure 10.—The average catch (no.) of northern searobin, *Prionotus carolinus*, per 10-min tow in Sandy Hook Bay, N.J., July to October 1970.

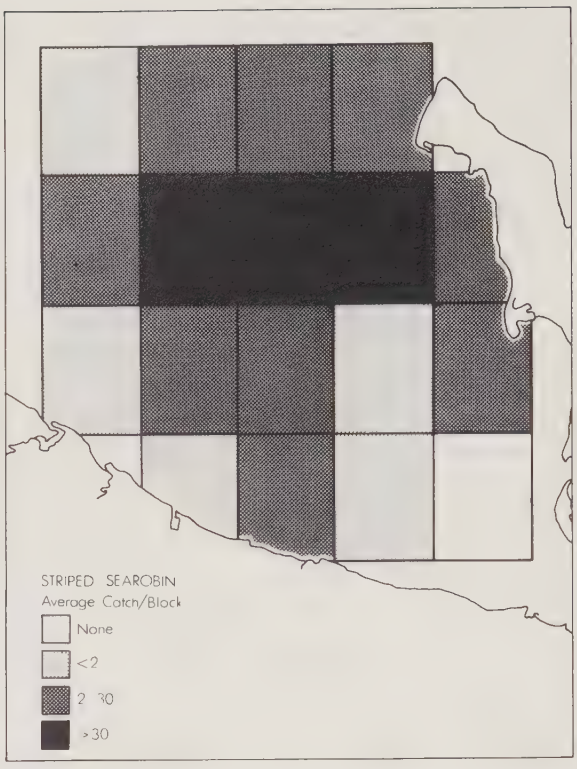

Figure 11.—The average catch (no.) of striped searobin, *Prionotus evolans*, per 10-min tow in Sandy Hook Bay, N.J., July to October 1970.

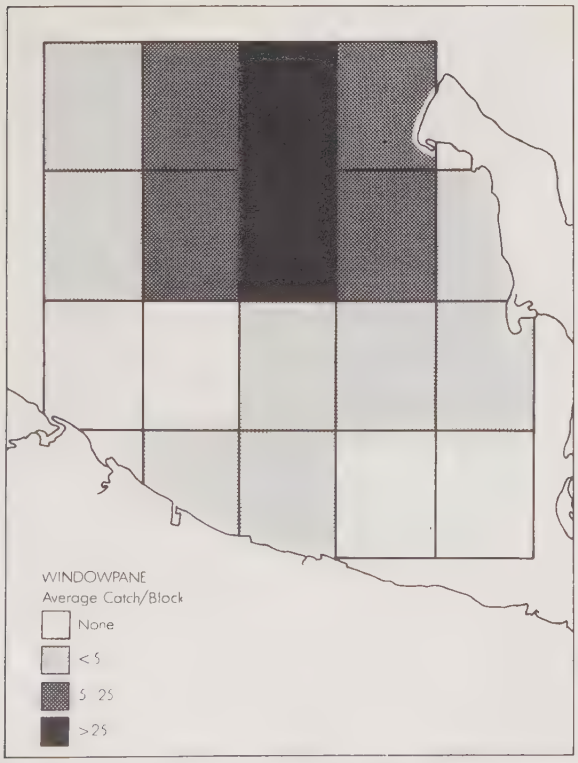

Figure 12.—The average catch (no.) of windowpane, *Scophthalmus aquosus*, per 10-min tow in Sandy Hook Bay, N.J., July to October 1970.

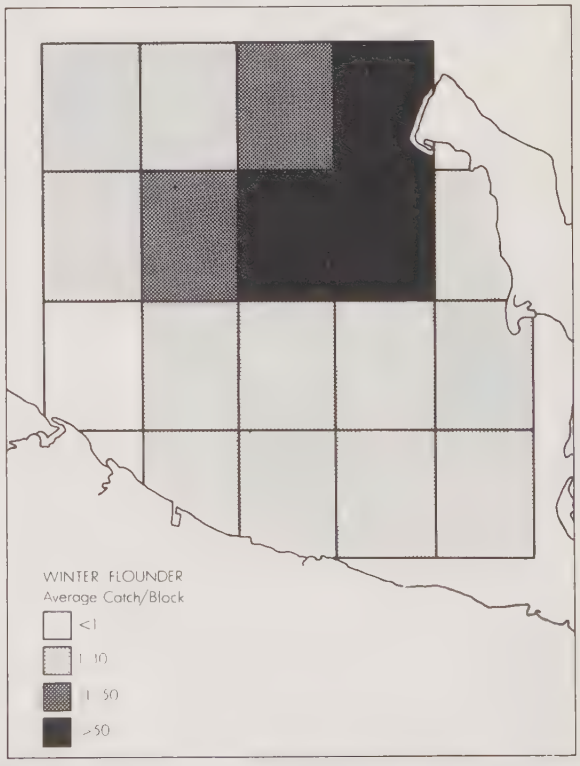

Figure 13.—The average catch (no.) of winter flounder, *Pseudopleuronectes americanus*, per 10-min tow in Sandy Hook Bay, N.J., July to October 1970.

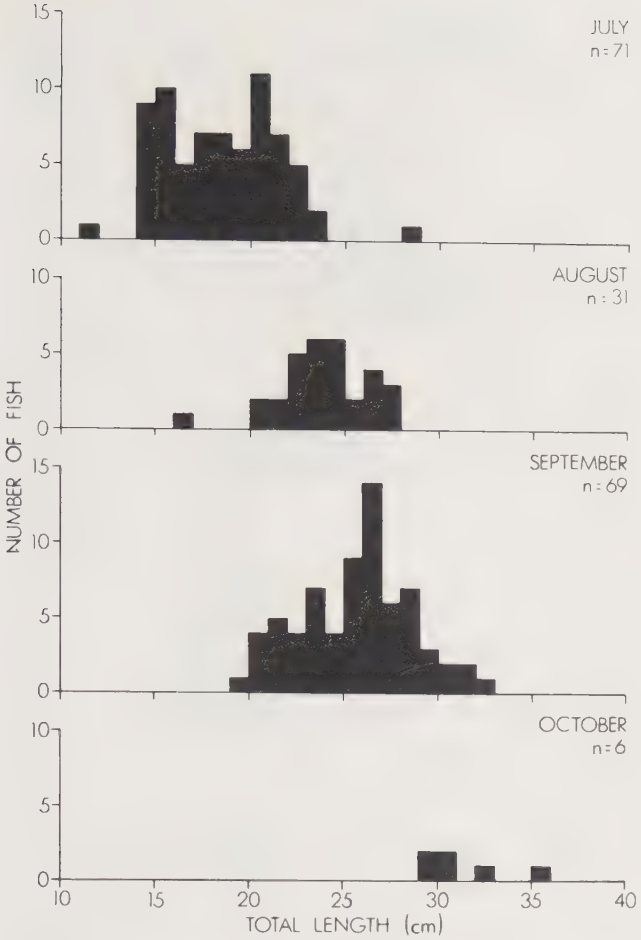

Figure 14.—Monthly length-frequency distributions of red hake, *Urophycis chuss*, collected in Sandy Hook Bay, N.J., July to October 1970.

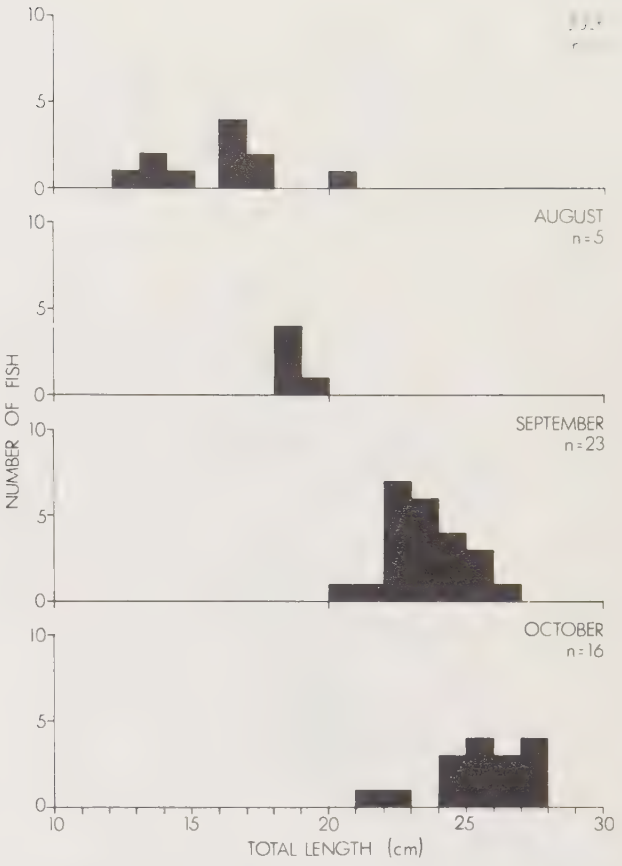

Figure 15.—Monthly length-frequency distributions of spotted hake, *Urophycis regius*, collected in Sandy Hook Bay, N.J., July to October 1970.

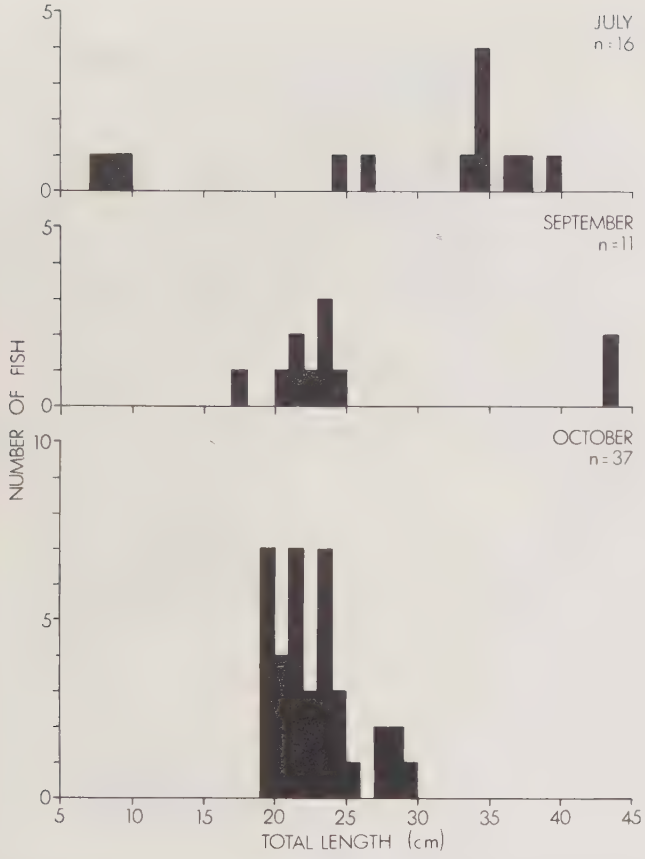

Figure 16.—Monthly length-frequency distributions of bluefish, *Pomatomus saltatrix*, collected in Sandy Hook Bay, N.J., July to October 1970.

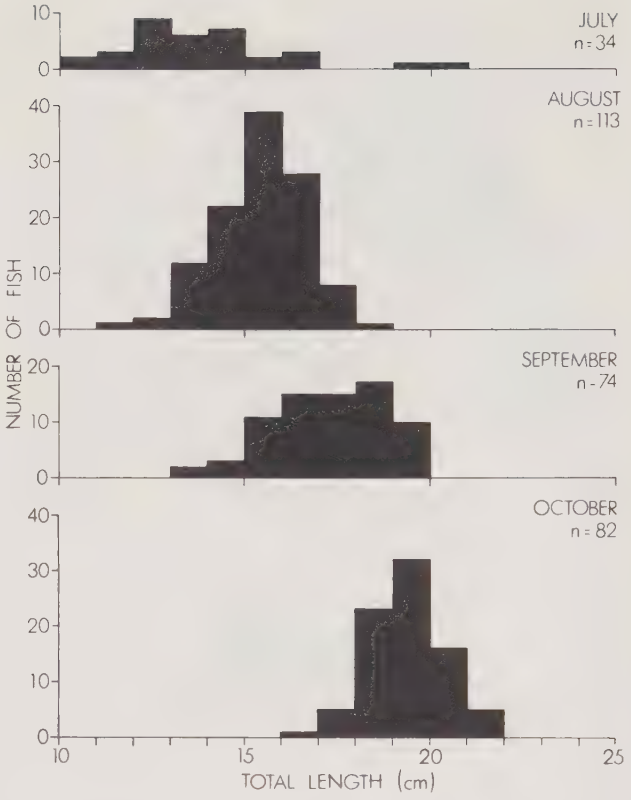

Figure 17.—Monthly length-frequency distributions of scup, *Stenotomus chrysops*, collected in Sandy Hook Bay, N.J., July to October 1970.

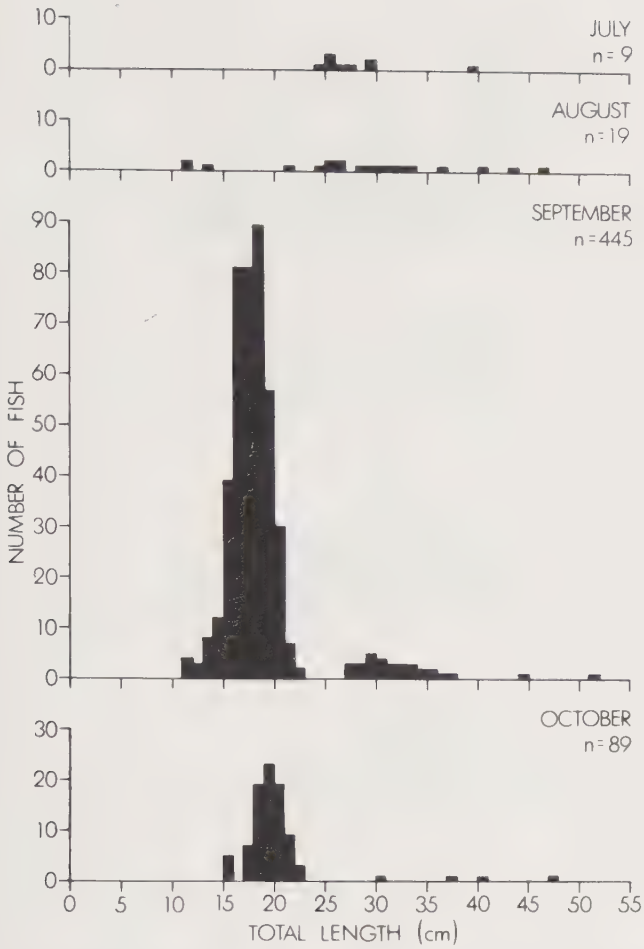

Figure 18.—Monthly length-frequency distributions of weakfish, *Cynoscion regalis*, collected in Sandy Hook Bay, N.J., July to October 1970.

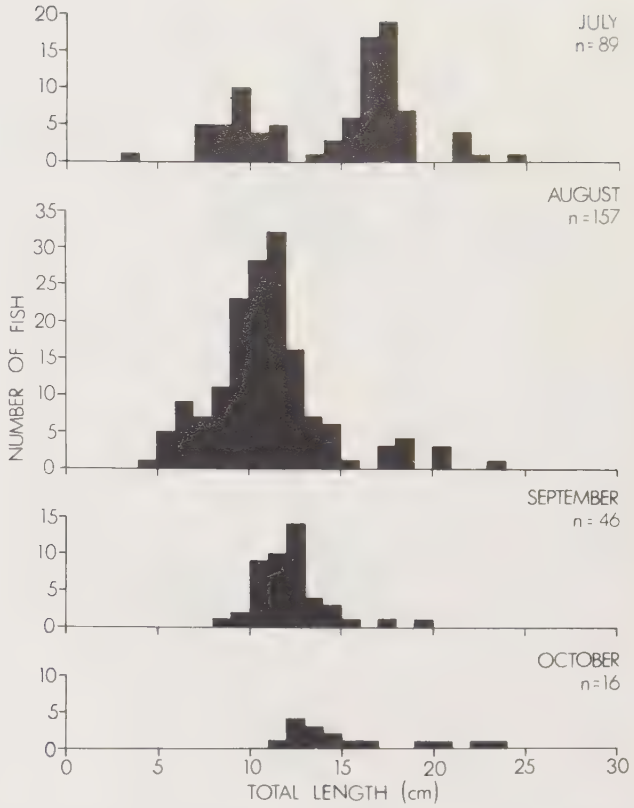

Figure 19.—Monthly length-frequency distributions of butterfish, *Peprilus triacanthus*, collected in Sandy Hook Bay, N.J., July to October 1970.

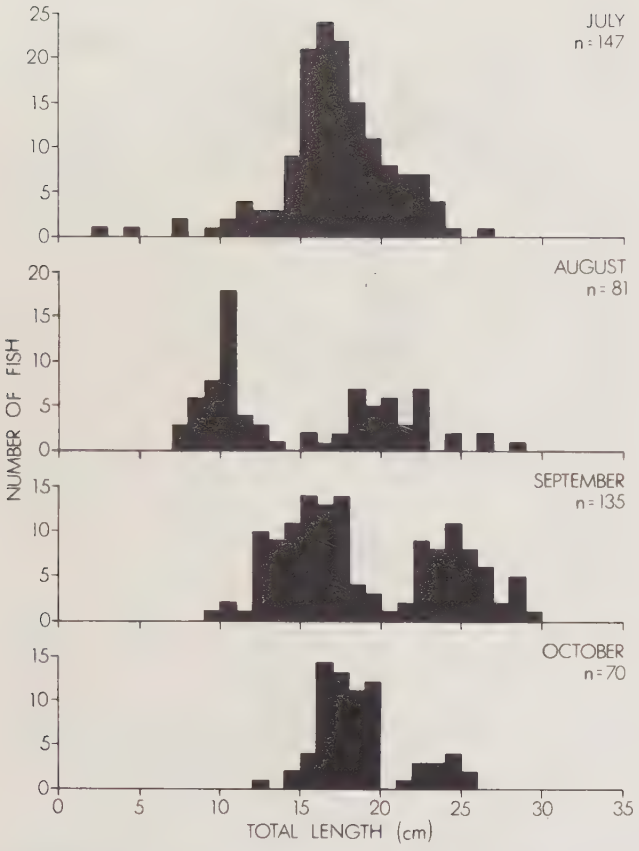

Figure 20.—Monthly length-frequency distributions of windowpane, *Scophthalmus aquosus*, collected in Sandy Hook Bay, N.J., July to October 1970.

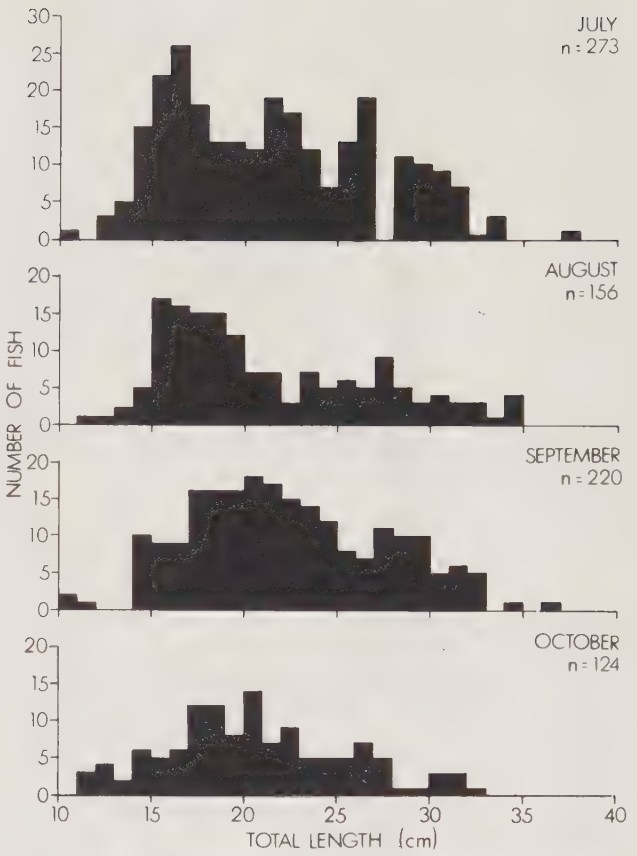

Figure 21.—Monthly length-frequency distributions of winter flounder, *Pseudopleuronectes americanus*, collected in Sandy Hook Bay, N.J., July to October 1970.

Appendix Table 1.--List of species captured in order of total number caught by otter trawl in Sandy Hook Bay, N. J., July to October 1970.

Species	Sample period: July 2	July 16-17	July 30-31	August 13-14	August 27-28	September 10-11	September 24-25	October 15-16	Total	Percent of total catch	Percent occurrence	Average catch per 10-min tow
	1	2	3	4	5	6	7	8				
Winter flounder	29[1]	158	464	334	40	374	176	142	1,717	21.7	61.6	15.3
Pseudopleuronectes americanus	6.35[2]	28.87	84.99	40.72	3.18	56.65	31.33	19.00	271.09	24.8		2.42
Striped searobin	26	20	331	157	494	195	396	26	1,645	20.8	44.6	14.7
Prionotus evolans	2.72	3.29	55.63	21.83	81.56	39.50	74.25	4.65	283.43	26.0		2.53
Windowpane	78	32	161	96	4	119	326	234	1,050	13.3	45.5	9.4
Scophthalmus aquosus	13.15	4.82	22.00	6.66	0.12	14.35	32.49	20.64	114.23	10.5		1.02
Northern searobin	31	45	537	293	5	69	19	--	999	12.6	25.9	8.9
Prionotus carolinus	3.29	2.84	29.52	13.44	0.57	5.56	1.31	--	56.53	5.2		0.50
Weakfish	--	3	6	18	1	166	286	95	575	7.3	24.1	5.1
Cynoscion regalis	--	1.02	1.25	4.88	0.23	13.19	30.50	13.44	64.51	5.9		0.58
Bay anchovy	72	265	34	43	6	--	4	--	424	5.4	24.1	3.8
Anchoa mitchilli	0.68	1.59	0.19	0.28	0.02	--	0.02	--	2.78	0.3		0.02
Scup	17	8	9	64	63	27	133	100	421	5.3	37.5	3.8
Stenotomus chrysops	1.36	0.63	0.37	3.91	4.10	2.54	14.06	13.72	40.69	3.7		0.36
Butterfish	45	38	12	184	11	2	56	16	364	4.6	47.3	3.3
Peprilus triacanthus	4.58	1.59	0.52	4.63	0.15	0.06	1.16	0.69	13.38	1.2		0.12
Red hake	53	13	53	9	40	58	26	6	258	3.3	14.3	2.3
Urophycis chuss	3.29	0.60	3.69	0.79	4.82	8.16	4.88	1.81	28.04	2.6		0.25
Summer flounder	4	2	16	20	2	12	12	1	69	0.9	37.5	0.6
Paralichthys dentatus	4.65	1.13	9.41	13.50	2.23	7.14	9.64	0.91	48.61	4.5		0.43
Bluefish	2	9	5	--	--	8	3	37	64	0.8	24.1	0.6
Pomatomus saltatrix	0.99	1.13	2.04	--	--	1.31	0.91	4.54	10.92	1.0		0.10
Spotted hake	1	5	5	5	--	8	15	16	55	0.7	13.4	0.5
Urophycis regius	0.06	0.17	0.17	0.35	--	0.91	2.04	2.72	6.42	0.6		0.6
Grubby	8	21	2	--	1	9	2	--	43	0.5	7.1	0.4
Myoxocephalus aenaeus	0.17	0.79	0.17	--	0.07	0.34	0.06	--	1.60	0.1		0.01
Atlantic moonfish	--	2	--	--	2	9	8	15	36	0.5	15.2	0.3
Vomer setapinnis	--	0.05	--	--	0.03	0.11	0.07	0.15	0.41	*[3]		±[4]
Alewife	18	8	1	--	--	--	4	2	33	0.4	15.2	0.3
Alosa pseudoharengus	1.17	0.28	0.06	--	--	--	0.11	0.03	1.65	0.2		0.01
Northern kingfish	--	--	--	3	1	11	9	9	33	0.4	6.3	0.3
Menticirrhus saxatilis	--	--	--	0.62	0.23	1.76	1.36	1.07	5.04	0.5		0.05
American eel	--	1	--	--	1	14	11	2	29	0.4	6.3	0.3
Anguilla rostrata	--	0.79	--	--	0.53	8.96	6.80	0.91	17.99	1.6		0.16
Atlantic menhaden	1	1	--	1	1	6	10	--	20	0.3	11.6	0.2
Brevoortia tyrannus	0.34	0.23	--	0.45	0.23	2.04	3.29	--	6.58	0.6		0.06
Northern puffer	--	--	1	6	--	6	2	--	15	0.2	8.9	0.1
Sphoeroides maculatus	--	--	0.23	0.10	--	0.71	0.68	--	1.72	0.2		0.02
Atlantic sturgeon	--	1	6	--	--	--	7	--	14	0.2	2.7	0.1
Acipenser oxyrhynchus	--	1.47	12.59	--	--	--	38.56	--	52.62	4.8		0.47
Silver perch	--	--	--	1	--	10	--	2	13	0.2	4.5	0.1
Bairdiella chrysura	--	--	--	0.23	--	1.25	--	0.14	1.62	0.1		0.01
Tautog	2	--	--	1	--	1	5	--	9	0.1	4.5	0.1
Tautoga onitis	1.81	--	--	0.23	--	0.06	2.15	--	4.25	0.4		0.04
Sea raven	--	--	5	2	--	--	--	--	7	0.1	1.8	0.1
Hemitripterus americanus	--	--	0.15	0.11	--	--	--	--	0.26	*		±
Shortnose sturgeon	--	1	3	--	--	2	--	--	6	0.1	2.7	0.1
Acipenser brevirostrum	--	5.44	19.28	--	--	15.88	--	--	40.60	3.7		0.36

Appendix Table 1.--Continued.

Species	Sample period: July 2 (1)	July 16-17 (2)	July 30-31 (3)	August 13-14 (4)	August 27-28 (5)	September 10-11 (6)	September 24-25 (7)	October 15-16 (8)	Total	Percent of total catch	Percent occurrence	Average catch per 10-min tow
Roughtail stingray	--	2	1	--	--	1	1	--	5	0.1	4.5	**[5]
Dasyatis centroura	--	4.99	2.27	--	--	2.04	3.63	--	12.93	1.2		0.10
American shad	--	--	1	--	--	--	1	--	2	*	1.8	**
Alosa sapidissima	--	--	0.23	--	--	--	0.23	--	0.46	*		±
Conger eel	--	--	--	--	--	1	--	1	2	*	1.8	**
Conger oceanicus	--	--	--	--	--	0.34	--	0.03	0.37	*		±
Smallmouth flounder	--	--	--	--	--	--	1	1	2	*	1.8	**
Etropus microstomus	--	--	--	--	--	--	0.03	0.01	0.04	*		±
Oyster toadfish	--	--	--	--	--	--	2	--	2	*	1.8	**
Opsanus tau	--	--	--	--	--	--	0.17	--	0.17	*		±
Planehead filefish	--	--	--	--	--	--	2	--	2	*	0.9	**
Monacanthus hispidus	--	--	--	--	--	--	0.06	--	0.06	*		±
Atlantic silverside	--	--	--	--	--	1	--	--	1	*	0.9	**
Menidia menidia	--	--	--	--	--	0.01	--	--	0.01	*		±
Blueback herring	1	--	--	--	--	--	--	--	1	*	0.9	**
Alosa aestivalis	0.03	--	--	--	--	--	--	--	0.03	*		±
Clearnose skate	--	--	1	--	--	--	--	--	1	*	0.9	**
Raja eglanteria	--	--	1.36	--	--	--	--	--	1.36	0.1		0.01
Lined seahorse	--	--	--	--	--	--	--	1	1	*	0.9	**
Hippocampus erectus	--	--	--	--	--	--	--	0.03	0.03	*		±
Lookdown	--	--	1	--	--	--	--	--	1	*	0.9	**
Selene vomer	--	--	0.01	--	--	--	--	--	0.01	*		±
Orange filefish	--	--	--	--	--	--	--	1	1	*	0.9	**
Aluterus schoepfi	--	--	--	--	--	--	--	0.57	0.57	0.1		0.01
Smooth dogfish	--	--	1	--	--	--	--	--	1	*	0.9	**
Mustelus canis	--	--	0.91	--	--	--	--	--	0.91	0.1		0.01
Striped burrfish	--	--	--	--	--	--	--	1	1	*	0.9	**
Chilomycterus schoepfi	--	--	--	--	--	--	--	0.06	0.06	*		±
Total	388	635	1,656	1,237	672	1,109	1,517	708	7,922			
	44.64	61.72	247.04	112.73	98.07	182.87	259.79	85.12	1,091.98			
Number of tows	7	13	18	18	15	12	18	11	112			
Average catch	55.4	48.8	92.0	68.7	44.8	92.4	84.3	64.4	70.7			
per 10-min tow	6.38	4.75	13.72	6.26	6.54	15.24	14.43	7.74	9.75			

[1]Number of fish.
[2]Weight of fish in kilograms.
[3]Less than 0.1% of total catch.
[4]Less than 0.01 kg per 10-min tow.
[5]Less than 0.1% fish per 10-min tow.

Appendix Table 2.--List of fishes captured by otter trawl in Sandy Hook Bay, N. J., July to October 1970, including summary data on time and location of capture, specimen size, and hydrographic characteristics at times of capture.

Species	Occurrence: Month(s)	Occurrence: Station block(s)	Total length: Range	Total length: Mean	Bottom temperature: Range	Bottom temperature: Mean	Bottom salinity: Range	Bottom salinity: Mean	Depth: Range	Depth: Mean	Remarks
			cm	cm	°C	°C	ppt	ppt	m	m	
Smooth dogfish *Mustelus canis*	July	4	--	62.0	--	22.9	--	26.2	--	7.0	
Clearnose skate *Raja eglanteria*	July	4	--	57.0	--	22.9	--	26.2	--	7.0	
Roughtail stingray *Dasyatis centroura*	July	4,13,17	80-100	90.0	21.0-22.2	21.6	26.0-26.9	26.4	5.5- 8.2	6.4	
	Sept.	7,10	--	100.0	21.4-22.2	21.8	26.7-28.8	27.8	3.0- 7.6	5.3	
Shortnose sturgeon *Acipenser brevoortia*	July	4	80-100	92.0	21.0-22.9	22.0	26.2-26.4	26.3	7.0- 8.2	7.6	Ninety percent of all sturgeon species were taken in block 4, the area of the survey most affected by currents, tides, and proximity to the ocean and other bay systems.
	Sept.	6	92-132	112.0	--	20.6	--	28.1	--	5.8	
Atlantic sturgeon *Acipenser oxyrhynchus*	July	4	70- 96	86.0	21.0-22.9	22.0	26.2-26.4	26.3	7.0- 8.2	7.6	
	Sept.	4	100-150	135.0	--	22.4	--	28.2	--	11.6	
American eel *Anguilla rostrata*	July	4	--	65.0	--	21.0	--	26.4	--	8.2	This species seemed to prefer the cooler and deeper waters found in the northern half of the bay.
	Aug.	11	--	67.0	--	24.4	--	25.8	--	3.0	
	Sept.	4,6,10	40- 55	48.3	20.6-22.4	21.3	26.7-28.3	27.8	3.0- 6.7	5.3	
	Oct.	10	41- 45	43.0	--	19.2	--	25.6	--	3.7	
Conger eel *Conger oceanicus*	Sept.	4	--	32.0	--	20.7	--	28.1	--	6.7	
	Oct.	6	--	17.0	--	18.8	--	26.2	--	9.1	
Blueback herring *Alosa aestivalis*	July	7	--	14.0	--	18.4	--	27.3	--	10.4	Herring species can only be considered incidental in our trawl catches because of their pelagic nature.
Alewife *Alosa pseudoharengus*	July	1,2,4,6,7	12- 28	14.6	18.4-22.9	19.8	26.1-27.3	26.6	7.0-10.4	8.6	
	Sept.	7	16- 18	17.0	--	22.2	--	28.8	--	7.6	
	Oct.	2	--	18.0	--	18.8	--	26.8	--	8.5	
American shad *Alosa sapidissima*	July	10	--	28.0	--	22.2	--	26.0	--	4.6	
	Sept.	4	--	34.0	--	22.4	--	28.2	--	11.6	
Atlantic menhaden *Brevoortia tyrannus*	July	9,13	29- 30	29.5	21.2-22.2	21.7	25.0-26.0	25.5	2.7- 5.5	4.1	
	Aug.	8,11	33- 39	36.0	23.9-24.4	24.2	25.8-27.6	26.7	3.0- 6.1	4.6	
	Sept.	1,4,6,7, 10,12, 14,15	30- 39	33.1	20.4-22.4	21.6	26.7-28.8	28.1	2.4-11.6	6.4	
Bay anchovy *Anchoa mitchilli*	July	1-3,5,6, 9-13,15, 17,18	6- 9	7.6	18.8-23.3	20.9	25.3-27.1	26.3	2.1-10.1	6.1	Most caught in southwest corner of the bay (Fig. 4).
	Aug.	1,2,6, 10-12, 14-16,18	7- 9	7.8	23.0-24.9	23.9	25.8-27.7	27.1	2.4- 6.7	5.0	Judging from stomach contents of bluefish and striped bass, the bay anchovy is a major food item of these higher predators.
	Sept.	1,7	6- 8	6.8	21.9-22.2	22.1	--	28.8	6.7- 7.6	7.2	
Oyster toadfish *Opsanus tau*	Sept.	16,18	14- 20	17.0	21.9-22.2	22.1	27.2-27.7	27.5	4.6- 5.2	4.9	

Appendix Table 2.--Continued.

Species	Occurrence: Month(s)	Occurrence: Station block(s)	Total length: Range	Total length: Mean	Bottom temperature: Range	Bottom temperature: Mean	Bottom salinity: Range	Bottom salinity: Mean	Depth: Range	Depth: Mean	Remarks
			cm	cm	°C	°C	ppt	ppt	m	m	
Red hake Urophycis chuss	July	1-4,6,7	11- 28	18.0	18.4-22.9	20.8	26.0-27.3	26.6	7.0-12.2	9.0	All taken in northern half of bay; 96% in blocks 1, 4, and 7 (Fig. 5). According to age-length data (Bigelow and Schroeder 1953), the majority of our catch (Fig. 14) was made up of yearlings.
	Aug.	1,7	16- 27	23.4	23.5-25.4	24.5	26.8-28.0	27.4	10.1-12.2	11.2	
	Sept.	4,7	19- 32	25.2	20.5-22.4	21.5	28.1-28.8	28.4	6.7-11.6	9.2	
	Oct.	1	29- 36	31.0	--	18.8	--	26.2	--	9.1	
Spotted hake Urophycis regius	July	3,4,8	12- 20	15.5	19.8-22.9	21.1	26.0-26.8	26.4	5.5-12.2	8.0	All but one taken in northern half of survey area; 74.5% in blocks 4 and 7 (Fig. 6). Catch was composed primarily of young-of-the-year specimens, as indicated by monthly length-frequencies (Fig. 15) and growth data given by Barans (1972).
	Aug.	3,7,12	17- 18	17.2	23.5-24.2	23.8	27.4-28.0	27.7	5.5-12.2	8.9	
	Sept.	3,4,7	20- 26	23.0	20.5-22.4	21.5	28.1-29.4	28.6	6.7-13.4	10.1	
	Oct.	6,7	21- 27	25.1	18.7-18.8	18.8	26.2-26.6	26.4	9.1- 9.8	9.5	
Atlantic silverside Menidia menidia	Sept.	11	--	6.0	--	21.5	--	27.0	--	1.8	Judging from previous examination of beach seine catches, this shore species is one of the most numerous in the survey area. From its lack of appearance in our trawl catch, it is apparent gear selectivity and the inshore habit of this species limited catches.
Lined seahorse Hippocampus erectus	Oct.	10	--	14.0	--	19.4	--	25.7	--	2.4	Year-round resident in New York Bight (Wicklund, Wilk, and Ogren, 1968).
Bluefish Pomatomus saltatrix	July	2,3,5, 10-15	7- 39	23.7	18.8-23.2	21.4	25.3-26.8	26.1	2.1-12.2	5.8	From age determinations based on scales (Wilk, unpublished data), 76.5% of our catch (Fig. 16) were young-of-the-year specimens.
	Sept.	1,2,4,5, 9,10,12, 15,17	17- 24	17.6	20.4-22.4	21.2	26.7-28.8	27.9	3.0-11.6	6.1	
	Oct.	1,2,5,6, 12,13,16	19- 43	24.6	18.0-19.0	18.6	26.0-27.1	26.4	4.0- 9.1	7.2	
Lookdown Selene vomer	July	6	--	4.0	--	21.4	--	26.7	--	7.3	
Atlantic moonfish Vomer setapinnis	July	14,17	5- 6	5.5	22.1-22.3	22.2	26.0-26.2	26.1	4.3- 5.5	4.9	Both the lookdown and Atlantic moonfish are considered only summer visitors from southern waters (Bigelow and Schroeder 1953, and Nichols and Breder 1927).
	Aug.	8	--	6.0	--	23.1	--	27.6	--	5.8	
	Sept.	1,5-7,9, 10	4- 8	7.1	20.6-22.4	21.5	26.7-28.8	28.0	3.0- 7.6	5.8	
	Oct.	1,2,5,7, 10,13,16	5- 8	6.0	18.0-19.2	18.7	25.6-27.1	26.4	3.7- 9.8	7.2	
Scup Stenotomus chrysops	July	4,6,8,10	10- 20	13.4	19.8-22.9	21.3	25.3-26.7	26.3	2.7- 8.5	6.6	Specimens taken in all blocks except 14, 16, 17, and 18; largest average catch in block 7 (21.8 per 10-min tow) (Fig. 7). Comparing monthly length-frequencies (Fig. 17) to age-length data given by Bigelow and Schroeder (1953) and Finkelstein (1969), the majority of the scup caught were probably yearlings.
	Aug.	1-6,8-11, 13	11- 18	14.9	22.7-25.4	23.9	25.8-27.7	27.2	2.4-10.1	5.9	
	Sept.	2,4-7, 9-12,15	13- 20	16.8	20.4-22.4	21.2	26.7-28.8	27.9	1.8-11.6	6.3	
	Oct.	2,6,7,10, 13	16- 21	18.9	18.0-19.2	18.7	25.6-26.8	26.2	3.7- 9.8	7.7	
Silver perch Bairdiella chrysura	Aug.	10	--	21.0	--	24.3	--	27.6	--	6.7	
	Sept.	4,12	10- 20	18.6	20.4-20.7	20.6	28.1-28.5	28.3	5.5- 6.7	6.1	
	Oct.	6,7	12- 22	17.0	18.7-18.8	18.8	26.2-26.6	26.4	9.1- 9.8	9.5	

Appendix Table 2.--Continued.

Species	Occurrence: Month(s)	Occurrence: Station block(s)	Total length: Range	Total length: Mean	Bottom temperature: Range	Bottom temperature: Mean	Bottom salinity: Range	Bottom salinity: Mean	Depth: Range	Depth: Mean	Remarks
			cm	cm	°C	°C	ppt	ppt	m	m	
Weakfish *Cynoscion regalis*	July	7,10,11	24- 39	27.7	20.8-22.2	21.6	25.6-27.0	26.2	2.1-10.7	5.8	Most (82.6%) were taken in northern half of survey area. Blocks 6 and 7 combined accounted for 55.8% of all weakfish caught (Fig. 8).
	Aug.	3,7-11,16	11- 46	27.9	23.5-24.9	24.2	25.8-28.0	27.2	2.4-12.2	6.1	
	Sept.	4-10,12	11- 51	18.2	20.5-22.5	21.5	26.7-29.5	28.2	3.0-11.6	6.6	
	Oct.	2,6,7,13	15- 51	19.8	18.0-18.8	18.6	26.0-26.8	26.4	7.6- 9.8	8.8	Comparing monthly length-frequencies (Fig. 18) to growth information given by Welsh and Breder (1924) and Bigelow and Schroeder (1953), the majority of the weakfish were probably 1- and 2-year-old fish; mostly the former.
Northern kingfish *Menticirrhus saxatilis*	Aug.	1,7,8,11	12- 30	24.8	23.0-24.4	23.7	25.8-28.0	27.2	3.0-12.2	6.9	All but three northern kingfish were caught in northern half of bay.
	Sept.	4,6,7,9, 10	17- 34	23.3	20.5-22.5	21.5	26.7-28.8	28.2	3.0-11.6	7.1	
	Oct.	1,6,10,16	11- 31	16.3	18.1-19.2	18.8	25.6-26.5	26.2	3.7- 9.1	7.0	
Tautog *Tautoga onitis*	July	4	23- 37	30.0	--	18.8	--	26.8	--	7.3	
	Aug.	10	--	19.0	--	24.7	--	26.7	--	3.7	
	Sept.	4,6	18- 26	19.2	20.7-22.4	21.8	28.1-28.3	28.2	5.8-11.6	8.0	
Butterfish *Peprilus triacanthus*	July	1-3,5-8, 10,11, 13-18	3- 24	14.1	18.4-22.5	21.0	25.3-27.3	26.3	2.7-10.7	5.7	Butterfish were taken in every block except 4; highest average catches in blocks 1, 2, and 11 (Fig. 9).
	Aug.	1,2,5-16, 18	4- 23	10.5	22.7-24.9	23.8	26.0-28.0	27.2	2.4-12.2	5.6	
	Sept.	1-3,6-8,12	8- 19	11.7	20.4-22.4	21.8	28.7-29.5	28.7	4.9-13.4	7.3	Judging from monthly length-frequencies (Fig. 19) and growth data given by Bigelow and Schroeder (1953), the majority of butterfish taken were in their second and third summers, with the yearlings dominating the catch.
	Oct.	1,6,7,16	11- 23	15.1	18.1-18.9	18.6	26.2-26.6	26.4	6.7- 9.8	8.5	
Northern searobin *Prionotus carolinus*	July	2-4,6-9, 12,14	12- 27	19.0	18.4-23.3	21.2	25.0-27.3	26.5	2.7-12.2	7.6	Almost all (99.1%) were taken in northern half of survey area; 62.5% in blocks 3 and 4 (Fig. 10).
	Aug.	3,4,6-9, 13,15	15- 20	17.5	23.1-24.5	24.0	26.8-28.0	27.4	3.7-12.2	6.9	
	Sept.	3,4,6,7	17- 21	19.4	20.5-22.4	21.3	28.1-29.4	28.5	5.8-13.4	9.4	According to growth data given by Wong (1968), our specimens were 1- to 7-year-old fish.
Striped searobin *Prionotus evolans*	July	2-4,6-10, 12-17	15- 30	20.0	18.4-23.3	21.3	25.0-27.3	26.5	2.7-12.2	6.8	Striped searobin were taken in all except block 18; 90.3% in northern half of survey area (Fig. 11). Blocks 6-8 accounted for 64.0% of this species total catch.
	Aug.	1-9,11,12, 14,16	12- 22	17.7	22.8-25.4	23.8	25.8-28.0	27.3	3.0-12.2	6.6	
	Sept.	1-8,10-12	9- 36	21.1	20.4-24.2	21.6	26.6-29.5	28.1	1.8-13.4	6.7	
	Oct.	1,2,5-7, 13-15	10- 35	19.5	18.7-19.2	18.9	25.9-27.1	26.4	2.4- 9.8	7.4	On the basis of age-length data given by McEachran and Davis (1970), it appears that our samples were composed of all ages from young-of-the-year to 6-year-old fish.
Sea raven *Hemitripterus americanus*	July	3	11- 12	11.5	--	21.9	--	26.1	--	7.6	
	Aug.	4	10- 15	12.5	--	24.4	--	27.3	--	6.1	
Grubby *Myoxocephalus aenaeus*	July	4,7	9- 18	11.6	18.4-22.9	20.6	26.0-27.3	26.6	7.0-10.7	8.7	All specimens taken in northern half of survey area; 81.4% in block 4.
	Aug.	1	--	10.0	--	25.4	--	26.8	--	10.1	
	Sept.	4	9- 18	11.5	20.7-22.4	21.6	28.1-28.2	28.2	6.7-11.6	9.2	

Appendix Table 2.--Continued.

Species	Occurrence: Month(s)	Occurrence: Station block(s)	Total length: Range	Total length: Mean	Bottom temperature: Range	Bottom temperature: Mean	Bottom salinity: Range	Bottom salinity: Mean	Depth: Range	Depth: Mean	Remarks
			cm	cm	°C	°C	ppt	ppt	m	m	
Smallmouth flounder *Etropus microstomus*	Sept.	5	--	12.0	--	21.8	--	27.7	--	4.6	
	Oct.	6	--	6.0	--	18.8	--	26.2	--	9.1	
Summer flounder *Paralichthys dentatus*	July	2-4,6-10, 12-16	32- 49	39.5	18.4-23.3	21.5	25.0-27.3	26.4	2.7-12.2	6.9	Judging from growth data given by Smith (1969), our samples were composed of fish 2-5 years old. This species is one of the most sought after by sportsmen in the area.
	Aug.	1-3,5-9, 11-13	35- 51	40.3	23.0-25.4	24.0	25.8-28.0	27.2	2.4-12.2	6.4	
	Sept.	2-7,9,12	29- 47	39.4	20.4-22.4	21.3	27.0-29.4	28.2	5.2-13.4	7.5	
	Oct.	5	--	40.0	--	19.0	--	27.1	--	5.8	
Windowpane *Scophthalmus aquosus*	July	2-8,12, 13,15	7- 31	21.7	18.4-22.9	21.0	25.9-27.3	26.6	4.3-12.2	7.8	Most windowpane (97.8%) were taken in northern half of survey area; 85.6% in blocks 3, 4, and 7 (Fig. 12).
	Aug.	1-9,13, 14,16	7- 28	14.6	22.7-25.4	23.8	26.8-28.0	27.4	4.6-12.2	6.5	
	Sept.	1-4,6,7, 14	9- 29	18.5	20.5-22.4	21.5	27.5-29.4	28.3	2.4- 9.8	7.0	Based on growth data given by Moore (1947) and monthly length-frequencies (Fig. 20), July catches were probably composed mainly of 4- and 5-year-old fish. In later months, 2- and 3-year olds predominated.
	Oct.	1,2,5-7, 12,13,15	12- 25	18.2	18.0-19.2	18.8	25.9-27.1	26.4	2.4- 9.8	7.0	Windowpane preferred the cooler and deeper waters found in the northern half of the survey area. All catches of more than 35 specimens, i.e., 77.7% of the total catch, were made in water which averaged nearly 4 m deeper and 1°C cooler than the survey average.
Winter flounder *Pseudopleuronectes americanus*	July	2-9,11-18	10- 37	21.3	18.4-22.2	21.3	25.8-27.3	26.5	2.4-10.7	6.4	Winter flounder occurred in all blocks. Heaviest catches in northern half of bay; 78.2% in blocks 3, 4, 6, and 7 (Fig. 13).
	Aug.	1-9,11-14	11- 34	20.8	23.0-24.9	23.8	26.8-28.0	27.4	2.4-12.2	6.3	
	Sept.	1-4,6-10, 12,14	10- 36	21.9	20.4-22.5	21.5	26.7-29.5	28.3	2.4-13.4	7.0	
	Oct.	1,5-7, 10-13, 15,16	11- 32	20.2	18.0-19.4	18.8	25.6-27.1	26.2	2.4- 9.8	6.0	Judging from data given by Bigelow and Schroeder (1953) and Lux (1973) and monthly length-frequencies (Fig. 21), the measured specimens were 1-4 years of age.
											Catches of over 100 individuals were all made in the 6.7- to 11.0-m depth range; the mean depth in which these larger catches were made is 2.8 m greater than the survey average.
Orange filefish *Aluterus schoepfi*	Oct.	6	--	32.0	--	18.8	--	26.2	--	9.1	Both species of filefish are rather common in general area during summer and fall (Nichols and Breder 1927).
Planehead filefish *Monocanthus hispidus*	Sept.	4	10- 11	10.5	--	22.4	--	28.2	--	11.6	
Northern puffer *Sphoeroides maculatus*	July	4	--	21.0	--	22.9	--	26.2	--	7.0	All specimens taken in northern half of survey area.
	Aug.	4-7	6- 8	7.0	23.5-24.4	23.9	26.8-28.0	27.4	3.7-12.2	7.2	
	Sept.	4,6,7,9	9- 27	18.5	20.6-22.4	21.3	28.1-28.8	28.3	5.8-11.6	7.3	
Striped burrfish *Chilomycterus schoepfi*	Oct.	6	--	10.0	--	18.8	--	26.2	--	9.1	This species, according to Bigelow and Schroeder (1953) and Nichols and Breder (1927), is an occasional summer visitor to New Jersey waters.

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